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(54) 직접확산 /부호분할다중접속 통신시스템의 데이터 송신기 및 수신기

*요약*

1. 청구범위에 기재된 발명이 속한 기술분야

직접확산/부호분할다중접속(DS/CDMA) 통신시스템을 개시하고 있다.

2. 발명이 해결하려고 하는 기술적 과제

정보신호의 온/오프현상이나 심한 진폭변동을 방지하여 데이터 및 클럭의 복원이 용이하도록 하는 데이터 송신기 및 수신기를 구현한다.

3. 발명의 해결 방법의 요지

본 발명의 데이터 송신기는 다수 채널의 정보신호를 확산할 시 첫 번째 채널의 I암 정보신호에는 I암 PN부호가 제공되도록 하고 Q암 정보신호에는 Q암 PN부호가 제공되도록 하며, 다음 일정한 수만큼 채널의 I암 정보신호에는 반전된 Q암 PN부호가 제공되도록 하고 Q암 정보신호에는 I암 PN부호가 제공되도록 하는 확산신호 생성장치를 포함한다. 본 발명의 데이터 수신기는 디지털의 I암 기저대역 확산신호와 Q암 기저대역 확산신호에 각각 I암 PN부호와 Q암 PN부호를 승산하고 이들 승산결과를 가산하여 I암 역확산신호를 생성하고, 디지털의 Q암 기저대역 확산신호와 I암 기저대역 확산신호에 각각 반전된 I암 PN부호와 Q암 PN부호를 승산하고 이들 승산결과를 가산하여 Q암 역확산신호를 생성하는 역확산신호 생성장치를 포함한다.

4. 발명의 중요한 용도

대역확산통신시스템.

*대표도*

# DECLARATION

I, the below-named translator, hereby declares:

(1) That my name, mailing address and citizenship are as stated below;

(2) That I am knowledgeable in the English language and in the Korean language in which Korean Patent No. 10-0174617 was registered on November 5, 1998; and

(3) That I have translated said Korean Paten No. 10-0174617 into English, which English text is attached hereto, and believes that said translation is a true and complete translation of the aforementioned Korean patent.

December 29, 2005

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# (54) DATA TRANSMITTER AND RECEIVER FOR DIRECT SPREAD/CODE DIVISION MULTIPLE ACCESS COMMUNICATION SYSTEM

Abstract

1. Field of the Claimed Invention

The present invention discloses a Direct Sequence (DS)/Code Division Multiple Access (CDMA) communication system.

2. Technical Problems Solved by the Invention

The present invention provides a data transmitter and data receiver that allow data and clock to be easily recovered by preventing an on/off phenomenon of information signal or severe amplitude variation.

3. Summary of the Invention

The data transmitter of the invention includes a spread signal

generation apparatus that provides an I arm Pseudo Noise (PN) code for I arm information signal of a first channel and a Q arm PN code for Q arm information signal, and then provides an inverted Q arm PN code for I arm information signal of a predetermined number of channels and I arm PN code for Q arm information signal. The data receiver of the invention includes a despread signal generation apparatus that multiplies a digital I arm baseband spread signal and a Q arm baseband spread signal by an I arm PN code and a Q arm PN code, respectively, and adds the multiplication results to produce an I arm despread signal, and multiplies a digital Q arm baseband spread signal and an I arm baseband spread signal by an inverted I arm PN code and a Q arm PN code, respectively, and adds the multiplication results to generate a Q arm despread signal.

4. Industrial Availability

The present invention can be advantageously used in a spread spectrum communication system.

【Specification】

【Title of the Invention】

DATA TRANSMITTER AND RECEIVER FOR DIRECT SPREAD/CODE DIVISION MULTIPLE ACCESS COMMUNICATION SYSTEM

【Brief Description of Drawings】

Fig. 1 is a block diagram of a transmitter for a conventional DS/CDMA communication system.

Fig. 2 shows a block diagram of a transmitter for a DS/CDMA communication system according to the present invention.

Fig. 3 provides a block diagram of a receiver for a DS/CDMA communication system according to the present invention.

Fig. 4 presents a detailed diagram of a configuration of the data demodulator shown in Fig. 3.

Figs. 5a and 5b are views showing signals processed in the

embodiment of the present invention.

【Detailed Description of the Invention】

The present invention relates to a spread spectrum communication system, and more particularly, to a data transmitter and receiver for a multiple access spectrum communication system using a pilot channel.

Generally, as signals transmitted in a spread spectrum communication system using a pilot signal, there are largely a pilot signal and data. The data implies an actual information signal to be transmitted, whereas the pilot signal always has a value of "1" and is a supplementary information signal transmitted to allow PN code synchronization to be easily made at a receiving end.

The spread spectrum communication system using the pilot channel simultaneously transmits the data and the pilot signal; and therefore, a synchronized demodulation of data is possible based on the pilot signal upon data demodulation at the receiving end. Further, since the pilot signal component always having the value of "1" is transmitted, pure PN code component whose I channel and Q channel PN code of pilot channel are not modulated is transmitted. Thus, it is possible to establish code synchronization with the pure PN code that is not modulated when performing the PN code synchronization at the receiving end. And, the pilot channel and data channel are divided by Walsh codes.

Fig. 1 shows a block diagram of a conventional data

transmitter for a spread spectrum communication system using a pilot channel. Firstly, a pilot signal and data are multiplied by Walsh odes created by a first and a fourth Walsh code generators 137 and 140 at a first and a fourth Walsh code modulators 126 and 129, respectively. Then, the outputs from the first and the fourth Walsh code modulators 126 and 129 are simultaneously divided into I channel and Q channel, respectively. The output from the first Walsh modulator 126 as pilot component is multiplied by an output from an I channel PN code generator 141 and spread at a first spreader 101 for I channel; and multiplied by an output from a Q channel PN code generator 142 and spread at a fifth spreader 105 for Q channel. The output from the fourth Walsh modulator 129 as data component is multiplied by the output from the I channel PN code generator 141 and spread at a fourth spreader 104 for I channel; and multiplied by the output from the Q channel PN code generator 142 and spread at an eighth spreader 108 for Q channel.

On the other hand, a synchronization signal Sync and a paging signal paging are multiplied by Walsh codes generated from a second and a third Walsh code generators 138 and 139 at a second and a third Walsh code modulators 127 and 128, respectively. Thereafter, the outputs from the second and the third Walsh code modulators 127 and 128 are simultaneously divided into I channel and Q channel, respectively. The output from the second Walsh modulator 127 as synchronization signal component is multiplied by the output from the I channel PN code generator 141 and spread at a second spreader 102 for I channel;

and multiplied by the output from the Q channel PN code generator 142 and spread at a sixth spreader 106 for Q channel. The output from the third Walsh modulator 123 as paging signal component is multiplied by the output from the I channel PN code generator 141 and spread at a third spreader 103 for I channel; and multiplied by the output from the Q channel PN code generator 142 and spread at a seventh spreader 107 for Q channel.

The spread outputs from the first to the fourth spreaders 101 to 104 are added at a first to a fourth combiners 109 to 112 and outputted through the first combiner 109; and then converted into analog signals and outputted via a first D/A converter 117.

The spread outputs from the fifth to the eighth spreaders 105 to 108 are added at a fifth to an eighth combiners 113 to 116 and outputted through the fifth combiner 113; and then converted into analog signals and outputted via a second D/A converter 118.

A first filter 119 filters and outputs the output signal from the first D/A converter 117, and a second filter 120 filters and outputs the output signal from the second D/A converter 118. At this time, a low pass filter may be used as each of the first and the second filters 119 and 120.

And then, the output from the first filter 119 is multiplied by an I phase component $COS\omega_{IFt}$ of an intermediate frequency signal created by an intermediate frequency signal

generator 121 at a first mixer 122, and the output from the second filter 120 is multiplied by a Q phase component $SIN\omega_{IFt}$ of the intermediate frequency signal converted by a phase converter 124 at a second mixer 123. The outputs from the first and the second mixers 122 and 123 are combined at a ninth combiner 175 and the combined signal is multiplied by $COS\omega_{RFt}$ at a third mixer 133.

Here, if $\omega_C$ is a carrier frequency, then generally $\omega_C = \omega_{IF} + \omega_{RF}$. The output from the third mixer 133 is passed via a Band Pass Filter (BPF) 134; and amplified at an amplifier 131 to transmit and then transmitted into space via an antenna.

However, since the above-described conventional transmitter for the spread spectrum communication system using the pilot channel employs a Quadrature Phase-Shift Keying (QPSK) spread spectrum method that spreads, for both of I channel and Q channel, the pilot signal and the data signal, its structure is complicated, which is not adapted to use in the multiple access spread spectrum communication system.

Moreover, the conventional spread spectrum communication system has a drawback that a code acquisition at a receiving end is more difficult due to degradation of cross correlation characteristic in combining the pilot and the data signal components in the multiple access system structure.

It is, therefore, a primary object of the present invention

to provide a data transmitter for a multiple access spread spectrum communication system by using a pilot channel employing a single PN code generator.

Another object of the present invention is to offer a channel data receiver for a multiple access spread spectrum communication system by using a pilot channel employing a single PN code generator.

A still another object of the present invention is to provide a channel data transceiver for a multiple access spread spectrum communication system by using a pilot channel employing a single PN code generator.

Hereinafter, a construction and an operation in accordance with a preferred embodiment of the present invention will be described in detail with reference to the accompanying drawings.

Fig. 2 shows a block diagram of a data transmitter for a multiple access spread spectrum communication system by using a pilot channel in accordance with a preferred embodiment of the present invention. A construction thereof will be given below.

First to Nth Walsh code generators 251 to 256 generate and output a first to an Nth Walsh codes, respectively.

A first Walsh code modulator 201 receives a pilot signal and multiplies it by the first Walsh code from the first Walsh

code generator 251 to provide a Walsh-modulated pilot signal.

A second Walsh code modulator 202 receives a control signal and multiplies it by the second Walsh code from the second Walsh code generator 252 to output a Walsh-modulated control signal.

A third Walsh code modulator 203 takes desired first traffic data for transmission and multiplies the same by the third Walsh code from the third Walsh code generator 253 to provide Walsh-modulated first traffic data.

A fourth Walsh code modulator 204 gets desired second traffic data for transmission and multiplies the same by the fourth Walsh code from the fourth Walsh code generator 754 to offer Walsh-modulated second traffic data.

A fifth Walsh code modulator 205 receives desired third traffic data for transmission and multiplies it by the fifth Walsh code from the fifth Walsh code generator 255 to offer Walsh-modulated third traffic data.

An Nth Walsh code modulator 206 takes desired (N-2)th traffic data for transmission and multiplies it by the Nth Walsh code from the Nth Walsh code generator 256 to offer Walsh-modulated (N-2)th traffic data.

A first PN code generator 248 creates and outputs a PN code in synchronization with a preset PN clock.

A first spreader 207 multiplies the Walsh-modulated pilot signal by the PN code to output a spread spectrum pilot signal.

A second spreader 208 multiplies the Walsh-modulated control signal by the PN code to provide a spread spectrum control signal.

A third spreader 209 multiplies the Walsh-modulated first traffic data by the PN code to provide spread spectrum first traffic data.

A fourth spreader 210 multiplies the Walsh-modulated second traffic data by the PN code to provide spread spectrum second traffic data.

A fifth spreader 211 multiplies the Walsh-modulated third traffic data by the PN code to output spread spectrum third traffic data.

An Nth spreader 212 multiplies the Walsh-modulated (N-2)th traffic data by the PN code to provide spread spectrum (N-2)th traffic data.

First to Nth Finite Impulse Response (FIR) filters 213 to 218 take the outputs from the first to the Nth spreaders 207 to 212 and conduct FIR filtering to provide FIR-filtered results, respectively.

First to Nth gain adjustors 219 to 224 adjust and output

the outputs from the first to Nth FIR filters 213 to 218, respectively.

A first D/A converter 226 converts the output from the first gain adjustor 219 into an analog signal.

An adder 225 adds and outputs the outputs from the second to Nth gain adjustors 220 to 224.

A second D/A converter 227 converts the output from the second to Nth gain adjustors 220 to 224 into an analog signal.

A first and a second Low Pass Filters (LPFs) 228 and 229 conduct LPF filtering for the outputs from the first and second D/A converters 226 and 227, respectively.

A first multiplier 231 takes an I channel output from the first LPF 228 as pilot signal component and a first intermediate frequency signal $COS\omega_{IFt}$ of certain I phase component, and multiplies the two signals to output a multiplied signal.

A second multiplier 231 receives a Q channel output from the second LPF 315 as control signal and traffic data signal component and a second intermediate frequency signal SIN $\omega_{IFt}$ of Q phase component, and multiplies the two signals to provide a multiplied signal.

A combiner 232 receives the outputs from the first and the second multipliers 230 and 231, and combines the two signals to output a combined signal.

A third multiplier 233 takes the output from the combiner 232 and a third intermediate frequency signal COS $\omega_{RF}t$, and multiplies the two signals to provide a multiplied signal.

A BPF 234 receives and band-filters the output from the third multiplier 233.

An amplifier 235 receives and amplifies the band-filtered signal by a predetermined amplification ratio to output an amplified signal via an antenna.

Fig. 3 is a block diagram of a data receiver for a multiple access spread spectrum communication system using a pilot channel in accordance with a preferred embodiment of the present invention. A construction thereof will be provided below.

A Low Noise Amplifier (LNA) 301 is a high frequency amplifier and amplifies and outputs a received signal via an antenna.

A BPF 302 in the receiver band-filters the received signal from the LNA 301.

A fourth multiplier 303 takes the band-filtered signal and

a third intermediate frequency signal $COS\omega_{RFt}$; and multiplies the two signals and converts a multiplied signal into a signal of intermediate frequency component.

A fifth multiplier 304 gets the output signal from the fourth multiplier 303 and a first intermediate frequency signal $SIN\omega_{IFt}$ of I phase component, and multiplies the two signals to output a multiplied signal.

A sixth multiplier 305 takes the output signal from the fourth multiplier 303 and a second intermediate frequency signal $SIN\omega_{IFt}$ of Q phase component, and multiplies the two signals to provide a multiplied signal.

A third and a fourth LPFs 306 and 307 conduct low-pass filtering for the output signals from the fifth and the sixth multipliers 304 and 305, and output low pass-filtered signals as spread component signals, respectively.

A first and a second A/D converters 308 and 309 convert the outputs from the first and the second LPFs 306 and 307 into digital signals, respectively.

A second PN code generator 300 receives a predetermined PN clock and generates a PN code in synchronization with the clock.

A first and a second despreaders 310 and 311 take the

digital-converted output signals from the first and the second A/D converters 305 and 309 and the PN code and multiply them, to output despread I channel signal I(t) and Q channel signal Q(t), respectively.

An eleventh Walsh code generator 361 generates and outputs the same first Walsh code as the first Walsh code of the transmitter as described above.

A twelfth Walsh code generator 362 produces and outputs the same second Walsh code as the second Walsh code of the transmitter as mentioned above.

A thirteenth Walsh code generator 363 creates and outputs the same third Walsh code as the (N-2)th Walsh code of the transmitter as described above.

An eleventh and a twelfth Walsh code demodulators 312 and 313 take the signals I(t) and Q(t) from the first and the second despreaders 310 and 311 and multiply each of them by the first Walsh code, to demodulate and output Walsh codes, respectively.

An initial synchronization and synchronization tracking unit 350 receives the Walsh code-demodulated signals I(t) and Q(t) from the first and the second Walsh demodulators 312 and 313 and conducts PN code synchronization and synchronization tracking of the two signals to thereby output a corresponding synchronization tracking result signal.

A PN clock controller 370 takes the synchronization tracking result signal and provides a corresponding clock control signal.

A PN clock generator 380 receives the clock control signal and creates a PN clock to control a generation of a PN code under the clock control signal.

A thirteenth and a fourteenth Walsh code demodulators 314 and 315 take the signals I(t) and Q(t) from the first and the second despreaders 310 and 311 and multiply each of them by the first Walsh code to demodulate and output Walsh codes, respectively.

A fifteenth and a sixteenth Walsh code demodulators 316 and 317 receive the signals I(t) and Q(t) from the first and the second despreaders 310 and 311 and multiply each of them by the second Walsh code to demodulate and output Walsh codes, respectively.

A seventeenth and an eighteenth Walsh code demodulators 318 and 319 accept the signals I(t) and Q(t) from the first and the second despreaders 310 and 311 and multiply each of them by the third Walsh code to demodulate and output Walsh codes, respectively.

First to sixth accumulation and dump units 320 to 325 receive, accumulate and dump each of the output signals from the

thirteenth to eighteenth Walsh code demodulators 314 to 319, respectively.

An eleventh multiplier 326 takes the output signals from the first and the fourth accumulation and dump units 320 and 323 and multiplies the two signals to output a multiplied signal.

A twelfth multiplier 327 takes the output signals from the second and the third accumulation and dump units 321 and 322 and multiplies the two signals to provide a multiplied signal.

A thirteenth multiplier 325 accepts the output signals from the second and the fifth accumulation and dump units 321 and 324 and multiplies the two signals to output a multiplied signal.

A fourteenth multiplier 329 takes the output signals from the first and the sixth accumulation and dump units 370 and 325 and multiplies the two signals to output a multiplied signal.

A first subtracter 340 receives the outputs from the eleventh and the twelfth multipliers 326 and 327 and subtracts the output of the twelfth multiplier 327 from the output of the eleventh multiplier 326.

A second subtracter 341 receives the outputs from the thirteenth and the fourteenth multipliers 328 and 329 and subtracts the output of the fourteenth multiplier 329 from the output of the thirteenth multiplier 328.

A control signal determination unit 342 takes the subtracted output from the first subtracter 340 and detects a phase thereof to lastly demodulate and output a control signal.

A data determination unit 343 accepts the subtracted output from the second subtracter 341 and detects a phase thereof to lastly output (N-2)th traffic data as demodulated data.

Hereinafter, an operation of a data transmitter and receiver for the multiple access spread spectrum communication system using the pilot channel in accordance with a preferred embodiment of the present invention will be described in detail with reference to Figs. 2 and 3 as mentioned above.

First of all, signals transmitted from the spread spectrum communication system using the pilot channel are largely composed of the pilot signal and data, as mentioned above. As described above, the pilot signal component constitutes an I channel signal and the data component forms a Q channel signal component. Signals transmitted in the preferred embodiment of the invention largely include a pilot signal, a control signal and data, wherein the pilot signal component constitutes an I channel signal, and the control signal and traffic data form a Q channel signal.

At first, a pilot channel allows an initial synchronization and a synchronization tracking to be easily made and is not modulated.

That is, data "1" is sent. Further, it is used as a reference pulse signal for synchronization demodulation at a mobile receiver. And, the control channel sends various parameters required for composition of multiple access spread spectrum system. For example, it is notified that a Walsh code sequence an ith mobile uses is wi. In addition, a base station ID and requisite system information are notified. Lastly, the data channel carries actual traffic data to be transmitted.

It is firstly defined that the number of maximum available traffic channels is N in the transmitter structure shown in Fig. 2 with the construction as mentioned above. Here, Walsh codes used in the pilot channel, the control channel, and the traffic channel have characteristic that is orthogonal to each other.

Now, an operation of a data transmitter in accordance with a preferred embodiment of the present invention will be described in detail with reference to the configuration of Fig. 2 as mentioned above. The first Walsh code modulator 201 receives a pilot signal and multiplies it by a first Walsh code from the first Walsh code generator 251 to provide a Walsh-modulated pilot signal. The second Walsh code modulator 202 takes a control signal and multiplies it by a second Walsh code from the second Walsh code generator 252 to output a Walsh-modulated control signal. The third Walsh code modulator 203 accepts desired first traffic data for transmission and multiplies the same by a third Walsh code from the third Walsh code generator 253 to provide Walsh-modulated first traffic

data. The fourth Walsh code modulator 204 gets desired second traffic data for transmission and multiplies the same by a fourth Walsh code from the fourth Walsh code generator 254 to offer Walsh-modulated second traffic data. The fifth Walsh code modulator 205 receives desired third traffic data for transmission and multiplies it by a fifth Walsh code from the fifth Walsh code generator 255 to output Walsh-modulated third traffic data. The Nth Walsh code modulator 206 takes desired (N-2)th traffic data for transmission and multiplies it by an Nth Walsh code from the Nth Walsh code generator 255 to provide Walsh-modulated (N-2)th traffic data.

The first to sixth spreaders 207 to 212 take the Walsh-modulated outputs from the first to the Nth Walsh modulators 201 to 206 and multiply each of them by a PN code to output spread spectrum pilot signal, control signal and traffic data, respectively.

After that, the spread spectrum pilot signal is FIR-filtered through the first FIR filter 213, gain-adjusted via the first gain adjustor 219, converted into I channel analog signal via the first D/A converter 226, low pass-filtered via the first LPF 228, and then multiplied by a first intermediate frequency signal $COS\omega_{IFt}$ of I phase component at the first multiplier 230.

Similarly, the spread spectrum control signal and traffic data are FIR-filtered through the second to the Nth FIR filters 214 to 218, gain-adjusted via the second to the Nth gain

adjustors 220 to 224, added at the adder 225, converted into Q channel analog signal via the second D/A converter 227, low pass-filtered via the second LPF 229, and then multiplied by a second intermediate frequency signal $SIN\omega_{IFt}$ of Q phase component at the second multiplier 231.

And then, the combiner 232 receives the outputs from the first and the second multipliers 230 and 231 and combines the two signals. The third multiplier 233 takes the output from the combiner 232 and multiplies it by a third intermediate frequency signal $COS\omega_{RFt}$ as carrier wave. The BPF 234 accepts and band-filters the output from the third multiplier 233, and the amplifier 235 receives and amplifies the band-filtered signal by a predetermined amplification ratio to transmit an amplified signal via an antenna.

Hereinafter, an operation of the data receiver in accordance with the preferred embodiment of the present invention will be described in detail with reference to the configuration of Fig. 3 as mentioned above. Firstly, a signal received via an antenna is multiplied by a carrier frequency signal $COS\omega_{RFt}$ at the fourth multiplier 303 after passing through the LNA 301 and the BPF 302. Thereafter, the signal from the fourth multiplier 303 is multiplied by a first intermediate frequency signal $COS\omega_{IFt}$ of I phase component at the fifth multiplier 304, converted into I channel digital signal via the third LPF 306 and the first A/D converter 308, multiplied by a

second intermediate frequency signal $SIN\omega_{IFt}$ of Q phase component at the sixth multiplier 305, and converted into Q channel digital signal via the fourth LPF 307 and the second A/D converter 309.

Next, the I channel and Q channel digital signals are multiplied by the PN code at the first and the second despreaders 310 and 311 to obtain I channel signal I(t) and Q channel signal Q(t).

The eleventh and the twelfth Walsh code demodulators 312 and 313 take the signals I(t) and Q(t) and multiply each of them by a first Walsh code to demodulate and output Walsh codes.

The initial synchronization and synchronization tracking unit 350 receives the Walsh code-demodulated signals I(t) and Q(t) from the eleventh and the twelfth Walsh demodulators 312 and 313 and conducts PN code synchronization and synchronization tracking of the two signals to output a corresponding synchronization tracking result signal. And then, the PN clock controller 370 takes the synchronization tracking result signal and provides a corresponding clock control signal, and the PN clock generator 380 receives the clock control signal and creates a PN clock to control a generation of a PN code under the clock control signal.

The thirteenth and the fourteenth Walsh code demodulators 314 and 315 take the signals I(t) and Q(t) and multiply them by

the first Walsh code to demodulate and output Walsh codes, respectively. The fifteenth and the sixteenth Walsh code demodulators 318 and 319 accept the signals I(t) and Q(t) and multiply them by the second Walsh code to demodulate and output Walsh codes, respectively. The seventeenth and the eighteenth Walsh code demodulators 318 and 319 accept the I(t) and Q(t) and multiply them by the third Walsh code to output demodulated Walsh codes, respectively. Subsequently, the first to the sixth accumulation and dump units 320 to 325 receive, accumulate and dump each of the output signals from the thirteenth to the eighteenth Walsh code demodulators 314 to 319.

The eleventh multiplier 326 takes and multiplies the output signals from the first and the fourth accumulation and dump units 320 and 323 to output a multiplied signal, the twelfth multiplier 327 receives and multiplies the output signals from the second and the third accumulation and dump units 321 and 322 to provide a multiplied signal, the thirteenth multiplier 328 takes and multiplies the output signals from the second and the fifth accumulation and dump units 321 and 324 to output a multiplied signal, and the fourteenth multiplier 329 accepts and multiplies the output signals from the first and the sixth accumulation and dump units 320 and 325 to output a multiplied signal.

The first subtracter 340 receives the outputs from the eleventh and the twelfth multipliers 326 and 327 and subtracts the output of the twelfth multiplier 327 from the output of the

eleventh multiplier 326, and the seventh subtracter 341 receives the outputs from the thirteenth and the fourteenth multipliers 328 and 329 and subtracts the output of the fourteenth multiplier 329 from the output of the thirteenth multiplier 328.

Thereafter, the control signal determination unit 342 takes the subtracted output from the first subtracter 340 and detects a phase thereof to lastly demodulate and output a control signal.

The data determination unit 343 then takes the subtracted output from the second subtracter 341 and detects a phase thereof to lastly demodulate and output (N-2)th traffic data.

In short, the (N-2)th data receiver first conducts the PN code initial synchronization and synchronization tracking of the transmitter; and once the PN synchronization is established, the receiver demodulates a control signal for control channel and is operated based on the control state of the transmitter (base station). For instance, if the content of the control channel implies that the connection is required by using the (N-2)th Walsh code, the (N-2)th receiver generates the Nth Walsh code to demodulate data.

As a result, the present invention as described above has an advantage that a structure of a receiver in each terminal of a multiple access spread spectrum communication system is simplified since the pilot signal only forms the I channel

signal component, the data only constitutes the Q channel signal component, and the I channel and Q channel signal components are all multiplied by the output from the same PN code generator.

In addition, the invention has an effect that a structure of a transmitter of a multiple access spread spectrum communication system is simplified since each transmission traffic channel employs orthogonal Walsh codes and multiplies each of them by the output from the same PN code generation means.

Furthermore, the invention has a merit that no degradation of code acquisition characteristic by cross correlation is occurred because pilot signal component is not affected by control signal or traffic data signal component due to an absence of process of combining spread signals.

【Claims】

1. A data transmitter for a multiple access spread spectrum communication system using a pilot channel, comprising:

a Walsh code generation means for receiving a pilot signal, a predetermined control signal and at least two data, and Walsh-modulating and outputting the signals and data as Walsh codes with code structure;

a spread spectrum means for accepting the Walsh-modulated pilot signal, control signal and data and conducting spread spectrum to a predetermined PN code;

a Finite Impulse Response (FIR) filtering means for receiving and FIR-filtering each of the spread spectrum output signals from the spread spectrum means;

an analog conversion means for taking the spread spectrum pilot signal, control signal and data that are filtered and outputted from the FIR filtering means, converting the filtered pilot signal into an analog signal, mixing the filtered control signal and data, and converting a mixed signal into an analog signal;

a low pass filtering means for accepting and low pass-filtering the output signals from the analog conversion means;

an intermediate frequency mixing and combining means for receiving the output signals from the low pass filtering means, multiplying each of them by a predetermined intermediate frequency signal, and combining multiplied signals to provide a signal the intermediate frequency signal is mixed;

a band pass filtering means for accepting and band pass-filtering the output signal from the mixing means; and

an amplification means for taking and amplifying the band pass-filtered signal by a predetermined amplification ratio.

2. The data transmitter as recited in claim 1, wherein the analog conversion means includes:

a first digital to analog conversion means for accepting and converting the pilot signal that is filtered and outputted from the FIR filtering means into an analog signal;

an addition means for receiving and adding the control signal and data that are filtered and outputted from the FIR filtering means; and

a second digital to analog conversion means for taking and converting the added output signal from the addition means into an analog signal.

3. The data transmitter as recited in claim 1 or 2, wherein the Walsh code generation means includes:

a Walsh code generator for generating and outputting Walsh codes corresponding to respective inputted signals; and

a modulation means for multiplying the inputted signals by the corresponding Walsh codes, respectively, to output Walsh code-modulated signals.

4. The data transmitter as recited in claim 1, further comprising a gain adjustment means for accepting the spread spectrum pilot signal, control signal and data that are filtered and outputted from the FIR filtering means and adjusting a gain of each of the signals to output adjusted signals to the analog

conversion means.

5. The data transmitter as recited in claim 4, wherein the analog conversion means includes:

a first digital to analog conversion means for accepting and converting the pilot signal that is filtered and outputted from the FIR filtering means into an analog signal;

an addition means for receiving and adding the control signal and data that are filtered and outputted from the FIR filtering means to output an added signal; and

a second digital to analog conversion means for taking and converting the added signal from the adding means into an analog signal.

6. The data transmitter as recited in claim 4 or 5, wherein the Walsh code generation means includes:

a Walsh code generator for generating and outputting Walsh codes corresponding to respective inputted signals; and

a modulation means for multiplying the inputted signals by the corresponding Walsh codes, respectively, to output Walsh code-modulated signals.

7. A data receiver for a multiple access spread spectrum communication system using a pilot channel, comprising:

a low noise amplification means for amplifying and outputting a signal received via an antenna;

a band pass filtering means for receiving and band pass-

filtering the output signal from the low noise amplification means;

an intermediate frequency removal means for multiplying the band pass-filtered signal by a predetermined intermediate frequency signal, to thereby provide I channel signal having spread spectrum pilot signal component the intermediate frequency signal component is removed, and Q channel signal having a mixed component of spread spectrum control signal and data;

a low pass filtering means for receiving and low pass-filtering each of the I channel signal and the Q channel signal to output low pass-filtered I channel and Q channel signals;

a digital conversion means for taking and converting each of the low pass-filtered I channel and Q channel signals into digital signals;

a despreading means for receiving each of the digital-converted I channel signal and Q channel signal and a predetermined PN clock, generating a PN code in synchronization with the PN clock, and multiplying each of the digital-converted I channel signal and Q channel signal by the PN code to thereby output despread I channel signal and Q channel signals;

a Walsh code demodulation means for accepting the despread I channel signal and Q channel signals, generating a Walsh code to demodulate a pilot signal, a Walsh code to demodulate a control signal, and a Walsh code to demodulate data of a

corresponding channel, and multiplying the despread I channel signal and Q channel signals by each of the Walsh codes to thereby provide pilot Walsh-demodulated I channel signal and Q channel signal, control signal Walsh-demodulated I channel signal and Q channel signal and data Walsh-demodulated I channel signal and Q channel signal;

an accumulation and dump means for receiving, accumulating and dumping each the Walsh code-demodulated I channel signal and Q channel signal;

a control signal determination means for accepting, mixing and adding each of pilot Walsh-demodulated I channel signal and Q channel signal and the control signal Walsh-demodulated I channel signal and Q channel signal from the accumulation and dump means, to determine and output a control signal corresponding to a phase of the added signal;

a data determination means for accepting, mixing and adding each of pilot Walsh-demodulated I channel signal and Q channel signal and the data Walsh-demodulated I channel signal and Q channel signal from the accumulation and dump means, to determine and output a control signal corresponding to a phase of the added signal;

an initial synchronization and synchronization tracking unit for receiving the pilot Walsh-demodulated I channel signal and Q channel signal, and establishing a PN code initial synchronization of the two received signals and tracking a

synchronization state, to output a synchronization tracking result signal corresponding to the tracking result; and

a PN clock generation means for taking the synchronization tracking result signal and providing a PN clock to control a generation of the PN code based the synchronization tracking result to the dispreading means.

8. The data receiver as recited in claim 7, wherein the control signal determination means includes:

a first multiplying means for accepting the pilot Walsh-demodulated I channel signal and the control signal Walsh-demodulated Q channel signal from the accumulation and dump means and multiplying the two signals;

a second multiplying means for receiving the pilot Walsh-demodulated Q channel signal and the control signal Walsh-demodulated I channel signal from the accumulation and dump means and multiplying the two signals;

a first addition means for taking and adding the output signals from the first and the second multiplying means; and

a control signal demodulation means for receiving the output signal from the first addition means and demodulating a control signal based on a phase of the received signal.

9. The data receiver as recited in claim 7 or 8, wherein the data determination means includes:

a first multiplying means for accepting the pilot Walsh-demodulated I channel signal and the data Walsh-demodulated Q channel signal from the accumulation and dump means and multiplying the two signals;

a second multiplying means for receiving the pilot Walsh-demodulated Q channel signal and the data Walsh-demodulated I channel signal from the accumulation and dump means and multiplying the two signals;

a first addition means for taking and adding the output signals from the first and the second multiplying means; and

a control signal demodulation means for receiving the output signal from the first addition means and demodulating data based on a phase of the received signal.